CLAIMS

What is claimed is:

1. An apparatus comprising:

a semiconductor substrate having a front side upon which an active device layer can be fabricated, and having a back side;

a diamond thermal layer coupled to the back side of the semiconductor substrate;

a back side component embedded in the diamond thermal layer; and

a via electrically connecting the back side component to the front side of the semiconductor substrate.

2. The apparatus of claim 1 wherein the back side component comprises a capacitor.

3. The apparatus of claim 1 wherein the back side component comprises an inductor.

4. The apparatus of claim 1 wherein the back side component comprises a resistor.

5. The apparatus of claim 1 wherein the back side component comprises an active component.

6. The apparatus of claim 1 further comprising:

the active device layer fabricated on the front side of the semiconductor substrate.

7. The apparatus of claim 1 further comprising:

a layer of thermal interface material overlying the diamond thermal layer; and

a thermal solution overlying the layer of thermal interface material.

8. The apparatus of claim 1 wherein the back side component comprises:

a plurality of layers of back side components.

9. The apparatus of claim 8 wherein the plurality of layers of back side components comprises:

a first plate anode and a first plate cathode of a first capacitor.

10. The apparatus of claim 9 wherein the plurality of layers of back side components further comprises:

a second plate anode and a second plate cathode of a second capacitor overlying the first capacitor.

11. An apparatus comprising:

a semiconductor die having a front side and a back side;

integrated circuit devices fabricated on the front side of the semiconductor die;

a layer of material disposed on the back side of the semiconductor die, the material having a thermal conductivity greater than 150W/mK and an electrical resistivity greater than 1E9Ω-cm; and

an electrical device disposed within the layer of material.

12. The apparatus of claim 11 wherein the electrical device is coupled to at least one of the integrated circuit devices by at least one via through the semiconductor die.

13. The apparatus of claim 12 wherein the electrical device comprises at least one of a capacitor, an inductor, and a resistor.

14. The apparatus of claim 13 further comprising:

a thermal solution coupled to the layer of material.

15. The apparatus of claim 14 wherein the thermal solution comprises a heat sink coupled to the layer of material with a layer of thermal interface material.

16. The apparatus of claim 11 wherein the electrical device comprises two layers of electrical devices.

17. The apparatus of claim 11 wherein the electrical device comprises an electro-optical interconnect device.

18. The apparatus of claim 11 wherein the material comprises diamond.

19. The apparatus of claim 18 wherein the electrical device comprises a capacitor.

20. The apparatus of claim 11 wherein the material has a thermal conductivity greater than 2000W/mK and an electrical resistivity greater than 1E15Ω-cm.

21. A method of manufacturing a semiconductor device, the method comprising:

forming a first layer of high thermal conductivity material on a back side of a semiconductor substrate;

forming a hole through the first layer of high thermal conductivity material and the semiconductor substrate;

forming a via in the hole;

forming a first device overlying the layer of high thermal conductivity material on the back side of the semiconductor substrate and in electrical connection with the via;

forming a second layer of high thermal conductivity material overlying the first device; and

forming a second device on a front side of the semiconductor substrate and in electrical connection with the via.

22. The method of claim 21 further comprising:

coupling a thermal solution to the second layer of high thermal conductivity material.

23. The method of claim 22 wherein the thermal solution comprises a heat sink and coupling the heat sink to the second layer of high thermal conductivity material comprises placing a layer of thermal interface material between the heat sink and the second layer of high thermal conductivity material.

24. The method of claim 21 wherein forming the first device comprises:

forming an anode and a cathode, and the first device comprises a capacitor.

25. The method of claim 24 wherein forming the anode and the cathode comprises:

fabricating the anode and the cathode to each have a plurality of fingers interlaced with fingers of the other.

26. The method of claim 24 wherein forming the anode and the cathode comprises:

forming the anode as a plate and forming the cathode as a plate, one of the plates overlying the other; and

forming a middle layer of high thermal conductivity material between the plates.

27. The method of claim 21 wherein the high thermal conductivity material comprises diamond.

28. The method of claim 27 wherein forming the layers of diamond comprises chemical vapor deposition.

29. The method of claim 21 further comprising, after forming the second layer of high thermal conductivity material and before forming the second device on the front side:

reducing a thickness of the semiconductor substrate.

30. The method of claim 21 wherein:

forming the hole comprises forming a plurality of holes;

forming the via comprises forming a plurality of vias in respective holes; and

forming the first device comprises forming a plurality of devices in electrical connection with respective subsets of the vias.

31. The method of claim 21 wherein forming the first device comprises:

fabricating a spiral inductor.

32. The method of claim 21 wherein forming the first device comprises:

fabricating a resistor.

33. The method of claim 21 wherein the high thermal conductivity material has a thermal conductivity greater than 150W/mK.

34. The method of claim 33 wherein the high thermal conductivity material has a thermal conductivity greater than 2000W/mK.

35. The method of claim 33 wherein the high thermal conductivity material has an electrical resistivity greater than 1E9Ω-cm.

36. The method of claim 35 wherein the high thermal conductivity material has a thermal conductivity greater than 2000W/mK.

37. The method of claim 36 wherein the high thermal conductivity material has an electrical resistivity greater than 1E15Ω-cm.

38. An article of manufacture comprising:

a machine-accessible medium including data that, when accessed by a machine, cause the machine to fabricate the apparatus of claim 1.

39. The article of manufacture of claim 38 wherein the machine-accessible medium further includes data that cause the machine to fabricate the apparatus of claim 2.

40. The article of manufacture of claim 38 wherein the machine-accessible medium comprises a recording medium.

41. The article of manufacture of claim 38 wherein the machine-accessible medium comprises a carrier wave.

42. An article of manufacture comprising:

a machine-accessible medium including data that, when accessed by a machine, cause the machine to fabricate the apparatus of claim 11.

43. The article of manufacture of claim 42 wherein the machine-accessible medium further includes data that cause the machine to fabricate the apparatus of claim 19.

44. The article of manufacture of claim 43 wherein the machine-accessible medium comprises a recording medium.

45. The article of manufacture of claim 43 wherein the machine-accessible medium comprises a carrier wave.

46. An article of manufacture comprising:

a machine-accessible medium including data that, when accessed by a semiconductor fabrication factory, cause the semiconductor fabrication factory to perform the method of claim 21.

47. The article of manufacture of claim 46 wherein the machine-accessible medium further includes data that cause the semiconductor fabrication factory to perform the method of claim 24.

48. The article of manufacture of claim 47 wherein the machine-accessible medium comprises a recording medium.

49. The article of manufacture of claim 47 wherein the machine-accessible medium comprises a carrier wave.